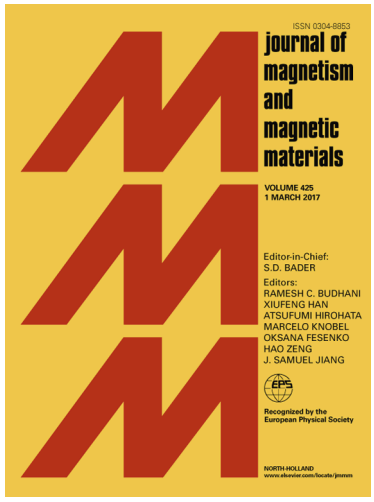

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Nonlinear gyrotropic motion of skyrmion in a magnetic nanodisk

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Abstract: We study the nonlinear gyrotropic motion of a magnetic skyrmion in a nanodisk by means of micromagnetic simulations. The skyrmion is driven by a linearly polarized harmonic field with the frequency of counterclockwise gyrotropic mode. It is found that the motion of the skyrmion displays different patterns with increasing field amplitude. In the linear regime of weak driving field, the skyrmion performs a single counterclockwise gyrotropic motion. The guiding center of the skyrmion moves along a helical line from the centre of the nanodisk to a stable circular orbit. The stable orbital radius increases linearly with the field amplitude. When the driving field is larger than a critical value, the skyrmion exhibits complex nonlinear motion. With the advance of time, the motion trajectory of the skyrmion goes through a series of evolution process, from a single circular motion to a bird nest-like and a flower-like trajectory and finally, to a gear-like steady-state motion. The frequency spectra show that except the counterclockwise gyrotropic mode, the clockwise gyrotropic mode is also nonlinearly excited and its amplitude increases with time. The complex motion trajectory of the skyrmion is the result of superposition of the two gyrotropic motions with changing amplitude. Both the linear and nonlinear gyrotropic motions of the skyrmion can be well described by a generalized Thiele's equation of motion.

Keywords: skyrmion; magnetic dynamics; nonlinear effect; micromagnetic simulation

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